4 PRACTICE AND APPLY

Assignment Guide

Answer Transparencies available for all exercises

Basic:
Day 1: EP p. 1010 Exs. 16–21
pp. 519–522
Exs. 1–8, 12–20, 54–58
Day 2: pp. 519–522
Exs. 24–39, 59, 62–70

Average:
Day 1: pp. 519–522
Exs. 1, 2, 5–10, 14–21, 54–58
Day 2: pp. 519–522
Exs. 27–31, 36–47, 59, 60, 62–70

Advanced:
Day 1: pp. 519–522
Exs. 1, 2, 6–11, 15–23, 54–58
Day 2: pp. 519–522
Exs. 28–31, 38–53*, 59–61*, 64–70 even

Block:
pp. 519–522
Exs. 1, 2, 5–10, 14–21, 27–31, 36–47, 54–60, 62–70

Differentiated Instruction

See *Algebra 2 Best Practices Toolkit* for suggestions on addressing the needs of a diverse classroom.

Homework Check

For a quick check of student understanding of key concepts, go over the following exercises:

Basic: 4, 14, 26, 32, 54

Average: 8, 18, 28, 36, 56

Advanced: 10, 22, 30, 40, 59

Extra Practice

- Student Edition, p. 1016
- Chapter 7 Resource Book: Practice levels A, B, C, pp. 65–67

Practice Worksheet

An easily-readable reduced practice page (with answers) for this lesson can be found on p. 476C.

EXAMPLE 2 on p. 516 for Exs. 12–23

SOLVING EXPONENTIAL EQUATIONS Solve the equation.

12. $8^x = 20$ about 1.441
13. $e^{-x} = 5$ about −1.609
14. $7^{3x} = 18$ about 0.495
15. $11^{5x} = 33$ about 0.292
16. $7^{6x} = 12$ about 0.213
17. $4e^{-2x} = 17$ about −0.723
18. $10^{3x} + 4 = 9$ about 0.233
19. $-3e^{2x} + 16 = 5$ about 0.650
20. $0.5^x - 0.25 = 4$ about −2.087
21. $\frac{1}{3}(6)^{-4x} + 1 = 6$ about −0.378
22. $2^{0.1x} - 5 = 7$ about 35.850
23. $\frac{3}{4}e^{2x} + \frac{7}{2} = 4$ about −0.203

EXAMPLE 4 on p. 517 for Exs. 24–31

SOLVING LOGARITHMIC EQUATIONS Solve the equation. Check for extraneous solutions.

24. $\log_5 (5x + 9) = \log_5 6x$ 9
25. $\ln (4x - 7) = \ln (x + 11)$ 6
26. $\ln (x + 19) = \ln (7x - 8)$ $\frac{9}{2}$
27. $\log_5 (2x - 7) = \log_5 (3x - 9)$ no solution
28. $\log (12x - 11) = \log (3x + 13)$ $\frac{8}{3}$
29. $\log_3 (18x + 7) = \log_3 (3x + 38)$ $\frac{31}{15}$
30. $\log_6 (3x - 10) = \log_6 (14 - 5x)$ no solution
31. $\log_8 (5 - 12x) = \log_8 (6x - 1)$ $\frac{1}{3}$

EXAMPLES 5 and 6 B on pp. 517–518 for Exs. 32–44

EXPONENTIATING TO SOLVE EQUATIONS Solve the equation. Check for extraneous solutions.

32. $\log_4 x = -1$ $\frac{1}{4}$
33. $5 \ln x = 35$ e^7 or about 1096.633
34. $\frac{1}{3}\log_5 12x = 2$ $\frac{15{,}625}{12}$
35. $5.2 \log_4 2x = 16$ about 35.601
36. $\log_2 (x - 4) = 6$ 68
37. $\log_2 x + \log_2 (x - 2) = 3$ 4
38. $\log_4 (-x) + \log_4 (x + 10) = 2$ −8, −2
39. $\ln (x + 3) + \ln x = 1$ about 0.729
40. $4 \ln (-x) + 3 = 21$ about −90.017
41. $\log_5 (x + 4) + \log_5 (x + 1) = 2$ about 2.720
42. $\log_6 3x + \log_6 (x - 1) = 3$ 9
43. $\log_3 (x - 9) + \log_3 (x - 3) = 2$ about 10.243

44. ★ **MULTIPLE CHOICE** What is the solution of $3 \log_8 (2x + 7) + 8 = 10$? A

Ⓐ −1.5 Ⓑ −1.179 Ⓒ 4 Ⓓ 4.642

45. The log was not simplified correctly, $x \log_3 6 \neq 2x$; $\log_3 6 \approx 1.631$, $x = 1.585$.

46. *Sample answer:* When converting the log to exponential form, 3 should have been used instead of e; $3^{\log_3 10x} = 3^5$, $10x = 243$, $x = 24.3$.

ERROR ANALYSIS *Describe* and correct the error in solving the equation.

45.
$$3^{x+1} = 6^x$$
$$\log_3 3^{x+1} = \log_3 6^x$$
$$x + 1 = x \log_3 6$$
$$x + 1 = 2x$$
$$1 = x$$

46.
$$\log_3 10x = 5$$
$$e^{\log_3 10x} = e^5$$
$$10x = e^5$$
$$x = \frac{e^5}{10}$$

47. ★ **OPEN-ENDED MATH** Give an example of an exponential equation whose only solution is 4 and an example of a logarithmic equation whose only solution is −3. *Sample answer:* $3^x = 81$, $\log_5 (x + 4) = 0$

C **CHALLENGE** Solve the equation.

48. $3^{x+4} = 6^{2x-5}$ about 5.374
49. $10^{3x-8} = 2^{5-x}$ about 2.879
50. $\log_2 (x + 1) = \log_8 3x$ no solution
51. $\log_3 x = \log_9 6x$ 6
52. $2^{2x} - 12 \cdot 2^x + 32 = 0$ 2, 3
53. $5^{2x} + 20 \cdot 5^x - 125 = 0$ 1

◯ = WORKED-OUT SOLUTIONS on p. WS1 ★ = STANDARDIZED TEST PRACTICE = MULTIPLE REPRESENTATIONS

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PROBLEM SOLVING

EXAMPLE 3 A on p. 516 for Exs. 54–58

54. COOKING You are cooking beef stew. When you take the beef stew off the stove, it has a temperature of 200°F. The room temperature is 75°F and the cooling rate of the beef stew is $r = 0.054$. How long (in minutes) will it take to cool the beef stew to a serving temperature of 100°F? **about 30 min**

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55. THERMOMETER As you are hanging an outdoor thermometer, its reading drops from the indoor temperature of 75°F to 37°F in one minute. If the cooling rate is $r = 1.37$, what is the outdoor temperature? **about 24°F**

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56. COMPOUND INTEREST You deposit $100 in an account that pays 6% annual interest. How long will it take for the balance to reach $1000 for each given frequency of compounding?

a. Annual **40 yr** **b.** Quarterly **38.75 yr** **c.** Daily **38.38 yr**

57. RADIOACTIVE DECAY One hundred grams of radium are stored in a container. The amount R (in grams) of radium present after t years can be modeled by $R = 100e^{-0.00043t}$. After how many years will only 5 grams of radium be present? **about 6967 yr**

58. ★ MULTIPLE CHOICE You deposit $800 in an account that pays 2.25% annual interest compounded continuously. About how long will it take for the balance to triple? **C**

(A) 24 years (B) 36 years

(C) 48.8 years (D) 52.6 years

EXAMPLE 7 B on p. 519 for Ex. 59

59. MULTIPLE REPRESENTATIONS The Richter scale is used for measuring the magnitude of an earthquake. The Richter magnitude R is given by the function

$$R = 0.67 \log (0.37E) + 1.46$$

where E is the energy (in kilowatt-hours) released by the earthquake. **a, b. See margin.**

a. Making a Graph Graph the function using a graphing calculator. Use your graph to approximate the amount of energy released by each earthquake indicated in the diagram above. **See margin for art.**

b. Solving Equations Write and solve a logarithmic equation to find the amount of energy released by each earthquake in the diagram.

Avoiding Common Errors

Exercises 5, 6 Because they could write both sides as powers of 5 in Exercise 3 and powers of 7 in Exercise 4, some students may think the idea is to write both sides as powers of the smaller base in the given equation. They then find that this does not work in these exercises. If this happens, review the property of equality for exponential equations and emphasize that they must write both sides as *powers* of the same base, not *multiples* of the same base. Remind them that the common base does not have to be one of the bases that appear in the original equation.

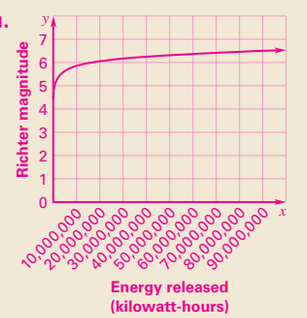
Teaching Strategy

Exercises 24–43 Be sure students are able to distinguish the type of equations in 24–31 that are solved by applying the property of equality for logarithmic equations, from the type in Exercises 32–43 that are solved by exponentiating both sides. The first type can be called "log = log" equations, and the second type, "log = number" equations. Give students additional mixed practice including both types of equations so that they will learn to distinguish between them and to choose the appropriate method of solution for each logarithmic equation they encounter.

Internet Reference

Exercise 59 More information about the Richter scale can be found at www. www.seismo.unr.edu/ftp/pub/louie/class/100/magnitude.html

59a.



59a. Japan: about 127,000,000 kilowatt-hours, Greece: about 11,500,000 kilowatt-hours, USA: about 23,500 kilowatt-hours.

59b. Japan: $6.6 = 0.67 \log(0.37E) + 1.46$, 126,893,702 kilowatt-hours; Greece: $5.9 = 0.67 \log(0.37E) + 1.46$, 11,446,269 kilowatt-hours; USA; $4.1 = 0.67 \log(0.37E) + 1.46$, 23,556 kilowatt-hours

5 ASSESS AND RETEACH

Daily Homework Quiz

Transparency Available

Solve the equation.

1. $25^x = 125^{-x+2}$ $\frac{6}{5}$
2. $8^x = 5$ about 0.77
3. $\log_7(5x - 8) = \log_7(2x + 19)$ 9
4. $\log_3(5x + 1) = 4$ 16
5. $\log_5 5x + \log_5(x - 4) = 2$ 5
6. Boiling water has a temperature of 212°F. Water has a cooling rate of $r = 0.042$. Use the formula $T = (T_0 - T_R)e^{-rt} + T_R$ to find the number of minutes t it will take for the water to cool to a temperature of 80°F if the room temperature is 72°F. about 13 min

Online Quiz

Available at **classzone.com**

Diagnosis/Remediation

- Practice A, B, C in Chapter 7 Resource Book, pp. 65–67
- Study Guide in Chapter 7 Resource Book, pp. 68–69
- Practice Workbook, pp. 118–119
- @HomeTutor

Challenge

Additional challenge is available in the Chapter 7 Resource Book, p. 72.

60. ★ **EXTENDED RESPONSE** If X-rays of a fixed wavelength strike a material x centimeters thick, then the intensity $I(x)$ of the X-rays transmitted through the material is given by $I(x) = I_0e^{-\mu x}$, where I_0 is the initial intensity and μ is a number that depends on the type of material and the wavelength of the X-rays. The table shows the values of μ for various materials. These μ-values apply to X-rays of medium wavelength.

Material	Aluminum	Copper	Lead
Value of μ	0.43	3.2	43

a. Find the thickness of aluminum shielding that reduces the intensity of X-rays to 30% of their initial intensity. (*Hint:* Find the value of x for which $I(x) = 0.3I_0$.) about 2.8 cm

b. Repeat part (a) for copper shielding. about 0.38 cm

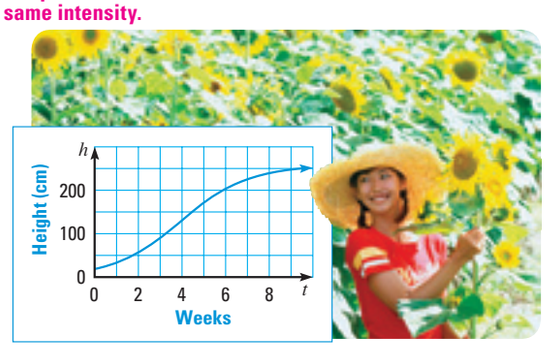
c. Repeat part (a) for lead shielding. about 0.03 cm

d. **Reasoning** Your dentist puts a lead apron on you before taking X-rays of your teeth to protect you from harmful radiation. Based on your results from parts (a)–(c), explain why lead is a better material to use than aluminum or copper. The lead apron does not have to be as thick as aluminum or copper to result in the same intensity.

C **61.** **CHALLENGE** You plant a sunflower seedling in your garden. The seedling's height h (in centimeters) after t weeks can be modeled by the function below, which is called a *logistic function*.

$$h(t) = \frac{256}{1 + 13e^{-0.65t}}$$

Find the time it takes the sunflower seedling to reach a height of 200 centimeters. about 5.9 wk



MIXED REVIEW

PREVIEW Prepare for Lesson 7.7 in Exs. 62–64.

Solve the system using any algebraic method. *(p. 160)*

62. $3x - y = 7$, $x + 2y = 14$ (4, 5)

63. $5x - y = 7$, $2x + 5y = -3$ $\left(1\frac{5}{27}, -1\frac{2}{27}\right)$

64. $x + 4y = -6$, $-2x + y = 12$ (−6, 0)

Determine the possible numbers of positive real zeros, negative real zeros, and imaginary zeros for the function. *(p. 379)* 65–68. See margin.

65. $f(x) = x^3 - 2x^2 + 5$

66. $f(x) = x^4 + 6x^3 - x^2 + 7x - 8$

67. $f(x) = x^5 - 3x^3 + 7x^2 + 6x + 9$

68. $f(x) = x^7 + 10x^6 - 5x^4 + 12x^3 - 17$

Use finite differences and a system of equations to find a polynomial function that fits the data. You may want to use a graphing calculator to solve the system. *(p. 393)*

69.

x	1	2	3	4	5	6
$f(x)$	19	28	27	16	−5	−36

$y = -5x^2 + 24x$

70.

x	1	2	3	4	5	6
$f(x)$	0	2	12	36	80	150

$y = x^3 - 2x^2 + x$

EXTRA PRACTICE for Lesson 7.6, p. 1016 **ONLINE QUIZ** at classzone.com

65. 2 or 0 positive real zeros, 1 negative real zero, 2 or 0 imaginary zeros
66. 3 or 1 positive real zeros, 1 negative real zero, 2 or 0 imaginary zeros
67. 2 or 0 positive real zeros, 3 or 1 negative real zeros, 4 or 2 or 0 imaginary zeros
68. 3 or 1 positive real zeros, 2 or 0 negative real zeros, 6 or 4 or 2 or 0 imaginary zeros

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